STATINTL [redacted]

To the Cochairmen of the Joint
American-Soviet Working Group
on Production of Substances
by Microbiological Means

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REPORT

ON THE VISIT IN THE USSR OF PROFESSOR LARRY E.ERICKSON OF KANSAS STATE UNIVERSITY IN THE FRAMEWORK OF PROJECT 2 SCIENTIFIC AND TECHNICAL COOPERATION IN ENGINEERING RESEARCH AND DEVELOPMENT OF EQUIPMENT AND TECHNIQUES FOR COMPUTERIZED SIMULATION, DESIGN AND CONTROL OF PROCESSES FOR MICROBIAL TECHNOLOGY.

In accordance with the agreement of june 19, 1974 reached in Washington D.C, in the period 17 may to 14 june 1975, there were working meetings in the USSR of professor Erickson with investigators of the soviet part of Project 2.

During the visit to Kasan S.M. Kirov Institute of Chemical Technology scientists from both sides gave oral reports on Project 2 research in the areas of mathematical modeling of microbiological processes and general directions in the development of sensors for microbiological processes. There was a useful exchange of information regarding research activities related to sections 2 and 3 of Project 2 in the areas of hydrodynamics, heat and mass transfer, and microbial population dynamics.

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In the course of the discussions on Project 2 research, broad possibilities for the intensification of microbiological processes through mathematical modeling, computers, and corresponding sensors development were explored. Both sides think that the results of the current research may be of significant practical value.

At the same time both sides think that the proposed fundamental research and development of equipment and methods are important in creating an improved scientific and technical basis for implementation of mathematical modeling and computer technology in the practice of development and design of new industrial fermentation processes and their computerized control. Both sides found that there is a mutual interest in development of joint research work in these directions.

At the present time, work at Kazan Institute of Chemical Technology is in progress on the structure of the general model for computer simulation of the hydrocarbon fermentation , oxygen transfer studies, and the population dynamics of microorganisms. Mass transfer research and model development for oxygen transfer and hydrocarbon substrate transfer are in progress at Kansas State University.

In both scientific organizations, considerable attention is paid to problems of mathematical modeling, computer simulation, optimal design, and synthesis of biotechnological processes. Both sides are interested in development of the corresponding methods and their application in fermentation processes. The scietists of both sides think further development of cooperation in the formulation of mathematical models which can be used in construction of a general model for the hydrocarbon fermentation process may

be worthwhile. Joint research in continuous phase hydrodynamic modeling, multiphase flow, and general model synthesis and identification techniques are also needed.

In the course of meeting, proposal on specifying of tasks outlined in Project 2 was developed (see APPENDIX 1). This proposal will be presented for consideration to the joint conference in Philadelphia in august of this year. It may be used in the development of coordinate plans.

In addition, proposal on specification of task1 of Project 2 was transfered to professor Erickson for consideration by american side.

During the visit professor Erickson was given the opportunity to get acquainted with the work in several departments and laboratories. He visited at Kazan Institute of Chemical Tectnology:
Chemical Cybernetics Department
Computing Center
Bioengineering Laboratory
Foreign Language Department
Varnish and Dye Technology Department
Electrochemical Processes Technology Department
Senior Project Laboratory of the Chemical Machinery Technology Department.

In Riga, he visited some institutions of the Latvian Academy of Sciences:

The August Kirchenstein Institute of Microbiology,

Experimental Biochemical Preparation Plant (instrumented laboratory scale fermentation units, seed culture production facility , new processes technology pilot plants which were under construction),

Institute of Electronics and Computer Technology,

Exhibition of National Economic Achievements of Latvian SSR (tower fermentor display).

In Moscow, he visited the All Union Institute for Protein Synthesis:
microbiological laboratory
biochemical laboratory
analytical laboratory
pilot plant facilities.
He also visited the Chemistry School of Moscow State University.

In Pushchino, he visited Institute of Biochemistry and Physiology of Microorganisms, AS USSR.

At the institutions listed above, information on current research activities was exchanged, professor Erickson was received by those in leadership positions, and matters of mutual interest were discussed. In addition during the visit to the Institute of Protein Synthesis, Project 2 research activities were discussed with scientists from the All Union Institutes of Biotechnology and Protein Synthesis.

During visits to Kazan and Moscow organizational matters related to the 1975 and 1976 Project 2 conferences were discussed. Proposed plans for the 1976 conference were formulated (see APPENDIX 2).

From USA

L.E. Erickson
principal investigator
on Project 2 research
at Kansas State
University

From USSR

S. G. YENIKEYEV

N.N. POSTNIKOV
Project 2
coordinators.

June 12, 1975
Moscow.

Appendix 1

PROPOSAL

ON SPECIFICATION OF TASKS 2 AND 3 OF PROJECT 2.

RESEARCH ON DEVELOPMENT OF MATHEMATICAL MODEL OF DISPERSED LIQUID PHASE.

1. Investigation of influence of biochemical factors and surface active substances on the state of the dispersed liquid phase.

2. Investigation of influence of hydrocarbon phase volume fraction and composition on its state and transport processes.

3. Investigation of the inluence of hydrodynamics of the continuons phase on the state of the dispersed liquid phase.

4. Investigation of the influence of the hydrocarbon phase dispersion on transport processes.

5. Development and investigation of techniques for measurement of dispersed liquid phase drop size distribution.

6. Development and investigation of techniques for measurement of residence time distribution for dispersed liquid phase.

7. Development and investigation of techniques for measurement of rates of coalescence and breakup of dispersed liquid phase droplets.

8. Development and investigation of a mathematical model for the dispersed liquid phase.

RESEARCH ON DEVELOPMENT OF MATHEMATICAL MODEL OF GAS PHASE.

1. Investigation of influence of biochemical factors and surface active substances on gas phase holdup and bubble size distribution.

2. Investigation of influence of gas phase on transport processes.

3. Investigation of influence of hydrodynamics of continuons phase on state of gas phase.

4. Development and investigation of techniques for measuring gas bubble distribution.

5. Development and investigation of tecniques for measuring the residence time distribution and rates of coalescence and break up of gas bubbles.

6. Investigation of foaming and defoaming processes.

7. Development and investigation of a mathematical model for the gas phase.

RESEARCH ON DEVELOPMENT OF MATHEMATICAL MODEL FOR THE CONTINUOUS PHASE.

1. Investigation of influence of biochemical factors on physico-chemical state of the continuous phase.

2. Investigation of influence of energizing methods on hydrodynamic state of continuous phase.

3. Development and investigation of measurement techniques for distribution of turbulent energy in working volume of fermentor.

4. Development and investigation of measurement techniques for residence time distribution of continuons phase and methods of identification of flow pattern.

5. Development and investigation of the mathematical model of the continuons phase.

RESEARCH ON DEVELOPMENT OF MATHEMATICAL MODEL OF MICROORGANISM POPULATION.

1. Investigation of kinetics of production and utilization of biochemical emulsifiers by microorganisms in hydrocarbon fermentations.

2. Investigation of mechanisms and kineticsof cellular affinity for hydrocarbon droplets and air bubbles.

3. Development and investigation of mathematical models of cellular stoichiometry, energetics and growth kinetics for hydrocarbon fermentations.

4. Investigation of transport processes between cells and the immediate environment in hydrocarbon fermentations.

5. Development and investigation of methods for obtaining information on key intracellular processes which are important in microbial population dynamics modeling on hydrocarbon Fermentations.

6. Development and investigation of techniques for measurement of residense time distribution of microorganisms.

7. Development and investigation of mathematical models for microbial population structure in continuons hydrocarbon fermentations.

RESEARCH ON DEVELOPMENT OF A GENERAL MATHEMATICAL MODEL OF THE HYDROCARBON FERMENTATION.

1. Investigation of interactions between different phases and the influence of biochemical factors and surface active agents on these interactions.

2. Development and investigation of mathematical models for interactions among phases.

3. Development and investigation of measurement techniques for gas-liquid and liquid-liquid interfacial tensions and spreading coefficients.

4. Investigation of influence of specific fermentor design features on transport processes and multiphase flow pattern.

5. Development and investigation of a general mathematical model of the hydrocarbon fermentation process.

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Appendix 2

PROPOSAL
ON PLANNING FOR 1976 CONFERENCE
IN USSR

Title of Conference

Mechanisms and kinetics of uptake and utilization by microorganisms for substrates of low solubility (2.1 and 3.1 of Project 2)

Location of Conference

Institute of Biochemistry and Physiology of Microorganisms Academy of Sciences of the USSR, Pushchino or All Union Institute of Protein Synthesis, Moscow

Dates of Conference

June 14-26, 1976 or July 5-17, 1976

Emphasis of Conference

1. This conference is to coordinate Parts 2.2, 2.3, 2.4, 3.2 and 3.3 of Project 2.
2. There will be a strong emphasis on physical and biochemical aspects of transport, uptake and utilization in heterogeneous cultures with four phases.
3. It is intended to consider methods and techniques for obtaining experimental results and mathematical models.
4. Cultures in which the carbon substrate is present as a separate phase will be considered:
   - 4.1. liquid and solid n-alkanes
   - 4.2. gas oil and related petroleum mixtures
   - 4.3. cellulose and solid wastes containing cellulose

Format of Program

First Day - Four papers with 1 hour for each presentation and 1 hour for discussion of each paper

Second Day - Four papers with 1 hour for each presentation and 1 hour for discussion of each paper

Third Day - Two papers with 1 hour for presentation and 1 hour for discussion of each paper (morning). Discussion of directions for future cooperative research (afternoon or evening).

Fourth Day - Coordination of specific subtasks

Fifth Day - Development of general report on status of research and recommendations on directions of future research.

Sixth Day - Final discussion and approval of general report and recommendations.

Number of Participants

Six official participants from each country plus observers active in Protect 2.

Open request
denied Phone

8 Jul 75

Microbiology Bldg -

Natick Labs - Army

Cellulose hydrolysis - Lab -

20 Aug -

Army - Obj to Soviet visit
to Natick Labs

State told 16 Jul 75

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Microbiology folder
1971 Bldg